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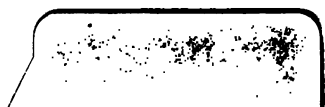
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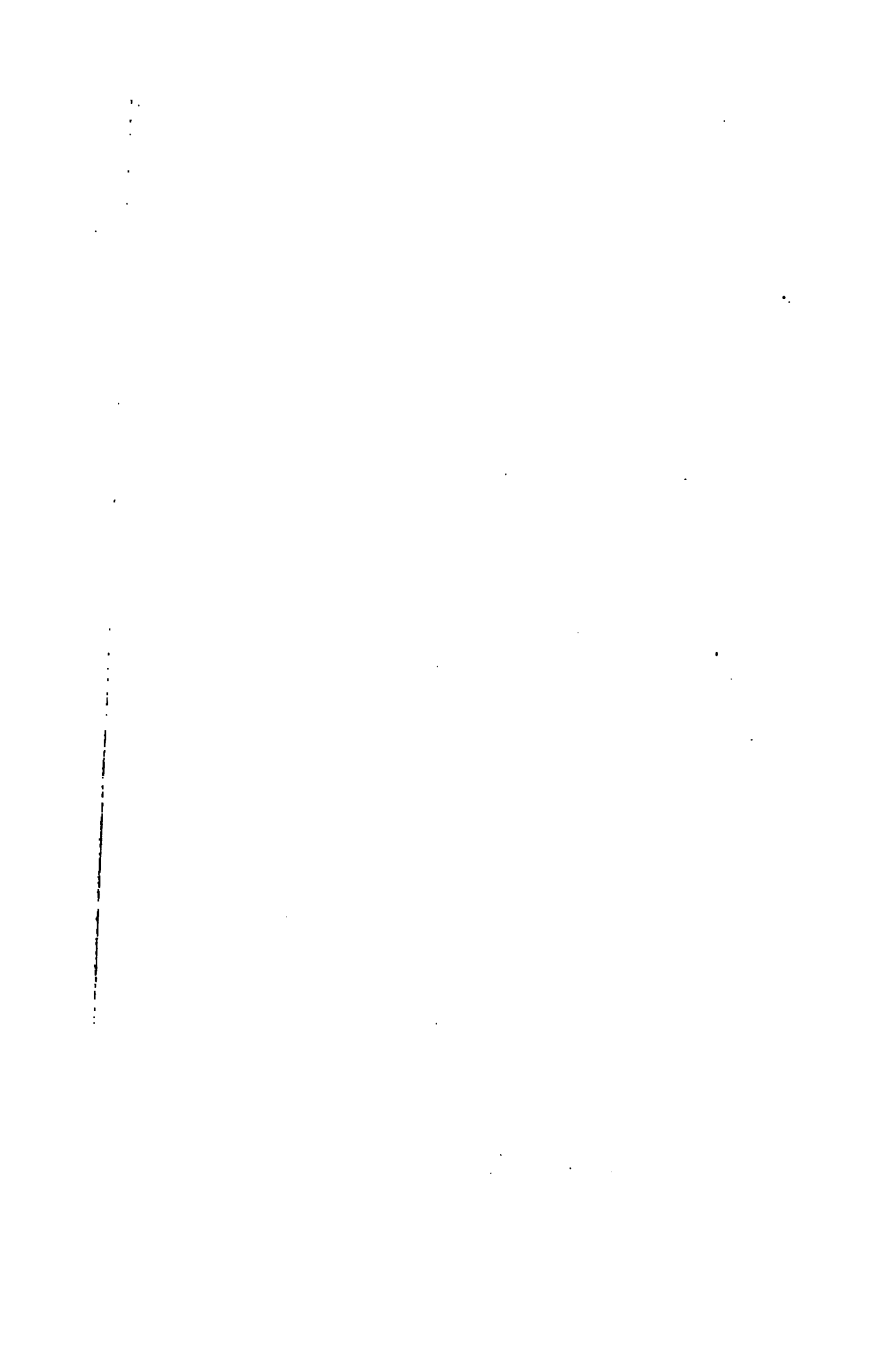
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ON
AFFECTIONS OF THE THROAT
AND LUNGS,
&c. &c.

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ON
Affections of the Throat
AND
Lungs,

And their Treatment by the Inhalation of Gases
and Medicated Vapours.

BY

ABBOTTS SMITH, M.D.,

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THIRD EDITION.



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PREFACE TO THE FIRST EDITION.

IN this Work, "On the Inhalation of Gases and Medicated Vapours," the Author has endeavoured to give a concise historical sketch of the subject, and an account of the principal uses of Inhalation.

The subject is one which, from its importance, might have been treated of at much greater length; but as the principal part of it was originally written for the Medical periodical in which it appeared, it was necessary to condense the matter as much as possible, and several points have been discussed in a few lines which might readily have been extended to as many pages.

In the publication of these remarks on Inhalation, the Author desires chiefly to draw additional attention to the value of this method of treatment, and to vindicate the Medical Profession from the charges

which had been brought against it, in certain quarters, of indifference to, or ignorance of, its merits.*

22, FINSBURY SQUARE,
LONDON, E.C.

* It should be mentioned, in explanation of this remark, that it was penned at a time when the general press teemed with monster advertisements, while some Journals even went the length to insert articles, making these unfounded charges against the medical profession, in connection with laudatory notices, of a person named Hunter, who claimed extraordinary skill in the application of a self-styled "novel" mode of treating disorders. This "novel" treatment was Inhalation, employed so ignorantly and recklessly that within a few months Hunter's career was cut short by the articles in the *Pall Mall Gazette*, out of which arose the action of Hunter v. *Pall Mall Gazette*. At this trial, Hunter's ignorance of the method which he professed to follow was fully shown, so that his charges rebounded upon himself.

PREFACE TO THE SECOND EDITION.

DURING the few months which have elapsed since the publication of the first edition of this Work, the employment of Inhalation in the treatment of affections of the lungs and air-passages has been more widely extended, and it promises, in due course of time, to become as commonly practised as any other local mode of medication.

No small amount of opposition to its introduction has been encountered in two different quarters ; on the one hand, arising from prejudice, the natural enemy of progress ; on the other, mainly attributable to the disgust which has not unreasonably been felt by those who have witnessed the extent to which inhalation has been made a medium for the practice of quackery.

As regards the first class of objectors, viz.—those who are prejudiced against this mode of

treatment merely because (as they say) it is novel, or, in other words, because they know nothing about it, it would be only a waste of time to attempt to argue with them, and it may be safely left to the gradual influence of time to remove such prejudices against Inhalation.

It will not, however, be out of place to discuss at somewhat greater length the objections raised by those who, while they are ready to admit that the judicious employment of Inhalation is frequently attended by benefit, hesitate to give it their support, principally on the second ground of objection which has already been mentioned.

Their argument, reasonable as it may at first sight seem, is, in point of fact, untenable. The same reasoning might be used against many very useful remedies. It is the conscientious duty of medical men, standing as they do, in the position of guardians of the public health, to show the real extent to which any particular method of treatment may be made beneficial, instead of relinquishing

it to any charlatans who may happen to seize hold of it, and whose combined cupidity and ignorance cannot fail to lead to the serious detriment of both the constitutions and purses of all individuals who may foolishly or incautiously seek relief at their hands.

Inhalation, like every other remedial means, cannot always succeed, but its great value in the treatment of a large proportion of pulmonary, bronchial, and laryngeal disorders, is daily becoming a more generally recognised fact.

PREFACE TO THE THIRD EDITION.

THE Author has introduced, in the present edition, a considerable amount of new matter, wherever it was requisite for the more complete elucidation of the subject, or arose out of additional experience of this method of treatment.

He takes this opportunity to explain, lest any misconception should arise upon this point, that, although he holds Inhalation in very high estimation in many cases of affections of the lungs and throat, he does not advise that reliance should be placed entirely upon it. For the physician to do this would be to deprive himself of many valuable remedies. It is, in fact, conjoined with other treatment that Inhalation will be found of the greatest advantage. Often superior to any other treatment, it is still more frequently beneficial when employed in combination with other remedies. It affords a

quick, agreeable, and safe means of acting locally upon the complaint, and at the same time powerfully aids any efforts which may be made by medicines administered in the ordinary manner.

In concluding these preliminary remarks, the Author feels that he cannot do better than quote the following appropriate passage from Sir Henry Holland's "Medical Notes and Reflections,"—"The great agent in determining the changes in the blood is undoubtedly the respiration. And, commanding this function as we do to a great extent, both in the quality and amount of what is inspired, we are bound to take more advantage than has yet been done of all which this important power can afford us for the relief of disease."

22, FINSBURY SQUARE, E.C.,

February, 1869.

ON THE TREATMENT OF
AFFECTIONS OF THE LUNGS & THROAT
By Inhalation, &c.

So much has recently been said and written in extra-professional circles on the subject of Inhalation as a remedial agent, and so evident is the fact that many persons look upon it as a novel mode of treatment, that it will not be altogether uninteresting to commence this general account of Inhalation by stating the opinions of some of the most ancient Professors of Medicine concerning it, in order to show that this mode of treatment possesses high claims to antiquity.*

* This paragraph was penned in 1866, when the public attention was considerably directed to the subject of Inhalation, in connection with the circumstances referred to in the note at page 6.

In their descriptions of the treatment of catarrh, coryza, and cough, Galen, Hippocrates, Aetius, Rhases, Ægineta, and other ancient writers recommended the inhalation of the fumes of various substances which are directed to be ignited, so that the patient may draw the vapour arising from them into his throat and lungs through a tube or funnel.

This was effected by means of a kind of jar, with an opening in the lid, into which a tube was passed, enabling the patient to inhale the vapour by placing his mouth at the opposite end of the tube.

Haly Abbas and other celebrated Arabian physicians, who, at a later period, were the sole possessors of medical learning, also speak very favourably, in their description of different remedies, of the inhalation of the vapours of camphor, lignum aloes, vinegar, and other substances.

In asthma and consumption, again, similar fumigations were recommended, and we find one old

author, Avicenna, speaking in high terms of the inhalation of the vapour of pine cones, a plan of treatment which has recently come into vogue in some parts of Germany.

References may also be met with, in some of the older treatises in medicine, to fumigations with various mineral substances, reduced to the condition of vapour, so as to be inhaled by the patient, in cases of secondary syphilis and other diseases.

Insufflation, a rude sort of inhalation, was also practised by the ancients in the treatment of affections of the larynx. This method, which consisted in blowing finely powdered medicinal substances into the larynx, through a small tube, has been successfully revived in modern times by Trousseau and others.

It would be easy, were it necessary, to multiply these instances of the value which was set upon Inhalation, not only by the oldest medical writers, but also by those of more recent date.

Inhalation was, however, chiefly confined to fumigations with the vapours of various vegetable, and occasionally mineral, substances, until towards the close of the last century, when the brilliant discoveries which were made of oxygen, and other gases, induced many distinguished physicians and scientific men to anticipate most favourable results from the inhalation of different gases in the treatment of consumption and other affections.

Seldom, perhaps never, before or since that period, has so noble a body of men existed, working in common upon the same subject for the cause of science and humanity, although widely separated from each other by distance, language, and the mighty events which then convulsed Europe: the list of whose names comprises Priestley, Beddoes, Humphry Davy, Cavendish, Erasmus Darwin, and James Watt, (the discoverer of the steam engine) in England; Lavoisier and Fourcroy, in France; Fontana and Spallanzani, in Italy; Ingenhousz, Girtanner, and Mensching, in Germany; and Odier, in Switzerland.

For the purpose of carrying out the views of the promoters, in this country, of the system of Pneumatic Medicine, as the mode of treatment by the inhalation of gases was called, an institution was founded at Clifton, near Bristol, by Dr. Beddoes, the originator of the system, with Humphry, afterwards Sir Humphry, Davy, (then just beginning his illustrious career) as superintendent.

Capacious reservoirs were constructed for the reception of large quantities of oxygen, carbonic acid, carburetted hydrogen, and other gases, and patients flocked to Clifton in considerable numbers from all parts of the country, to avail themselves of Dr. Beddoes' treatment.

Various circumstances, however, amongst which may be included the too sanguine expectations of the founder of this establishment, the costly nature of the apparatus employed, and the inadequacy of the funds provided for carrying out the original design of the promoters, led to the ultimate abandonment of the project, but not before

researches had been conducted on a sufficiently large scale to show that much benefit might be derived from the inhalation of some of the gases which were experimented upon, especially oxygen, if some plan could be devised by which they could be prepared, in a less expensive manner, and by portable apparatus, so that patients could use them at their own homes, instead of being compelled (sometimes in the later stages of disease) to undertake long and injurious journeys.

Those readers who desire additional details of the history of Dr. Beddoes' and Humphry Davy's labours, will find much interesting information in "Beddoes' Letter to Erasmus Darwin, M.D., on a New Method of Treating Pulmonary Consumption," &c., published in 1793, in Davy's "Chemical and Philosophical Researches," written by the latter whilst he was superintendent of the Medical Pneumatic Institution, and published in 1800, and also in the valuable Memoir of Sir Humphry Davy, edited by his brother, Dr. John Davy.

During his residence at the Clifton Pneumatic Institution, Davy experimented upon all of the gases then known. In conducting some experimental researches on the properties of nitrous oxide, he discovered that its inhalation mitigated the pain of cutting a wisdom tooth, and, from other circumstances connected with its inhalation, he threw out the suggestion that as it appeared to be "capable of destroying physical pain, it might probably be used with advantage during surgical operations." From this discovery by Davy, and the subsequent observation, that the inhalation of ether, when pure or medicated with conium or some other vegetable sedative, allayed the irritation in asthma, whooping cough, and some other spasmodic disorders, may be traced the discovery of the inestimable boon of chloroform as an anæsthetic.

The impediments which have been referred to, as greatly preventing the use of gases for inhalation, continued for many years to baffle medical prac-

titioners who were desirous of employing it in the treatment of pulmonary affections. Laennec, in his treatise on "Mediate Auscultation, and Diseases of the Heart and Lungs," remarks that "no means could seem better calculated to combat the dyspnœa which arises from increased want of respiration, in spasmodic asthma, than the inhalation of pure oxygen;" but, he adds, the difficulty of promptly procuring it formed almost a complete bar to its employment.

This difficulty no longer exists, for oxygen can now be quickly prepared in sufficient quantity, and at such a moderate cost as to allow of its general use; and—a point which is of still greater importance—the trials which have been made of it by various observers show that it possesses remedial powers of very great value.

The largest and most complete series of experiments with oxygen gas, both upon animals and human beings, are those which, during several years, were conducted by my esteemed friend,

M. Demarquay, of Paris, in conjunction with M. Leconte. These careful and trustworthy observers have recently embodied the results of their researches in a Report presented to the Academy of Sciences, at Paris; and their conclusions respecting the physiological and therapeutical properties of oxygen so nearly correspond with those of other experimenters upon this gas, that they may be advantageously epitomised in the following description of the effects of oxygen, when it is inhaled.

The first series of experiments, conducted by MM. Demarquay and Leconte, comprising a large number of observations, had relation to the action of oxygen on animals only.* In these

* With reference to experiments conducted upon animals, physiologists have of late been attacked, in no measured terms of reproach and abuse, for the alleged cruelties committed by them in the prosecution of their inquiries. Without entering upon a lengthy defence of scientific men against such charges, it may be observed, that a physiologist, working for the improvement of science, and the ultimate

experiments it was ascertained that a dog is able to respire as much as thirty or forty litres* of oxygen, or even more, without injury ; in fact, on the contrary, the only apparent result of the inhalation is to render the animal more lively, and to improve his appetite. In some instances wounds were made in the axillary region, and the animals were obliged to inhale oxygen when these wounds were undergoing the process of healing. It was then observed that the wounded parts

benefit of the human race, inflicts less pain and torture in the course of a whole year than many a sportsman causes in a few days' shooting, indulged in merely for the gratification of his own pleasure. A rabbit (one of the animals most commonly selected for physiological experiments) would suffer far less pain at the hands of a physiologist who, whenever practicable, would most probably render it insensible by the administration of chloroform, previous to the commencement of his experiments, and who would certainly put it to a speedy death afterwards, than the same animal would suffer at the hands of a sportsman, if, with broken leg or mangled body it managed to escape into a hole to perish, and thus get a tedious termination to its misery.

* A litre is reckoned as equal to 1.76 English pints.

became brightly injected with arterial blood, and that a transparent serous fluid was effused at the surface ; and, further, that as the inhalation of the gas was continued, numerous petechiæ, or ecchymoses, were produced. In order to ascertain whether similar results would be caused by the injection of oxygen into the venous system, a series of injections were made into the jugular vein, and the same effects were always produced as when inhalation was practised. The principal results shown by the summary of the researches of MM. Demarquay and Leconte into the effects of the inhalation of oxygen upon animals, are :—

1.—That after death, induced by the long-continued respiration of the gas, the muscles of the animals experimented upon were always found in a swollen condition.

2.—That, contrary to the opinion advanced by Broughton, one of the earliest inquirers into the physiological action of oxygen, the venous and arterial blood retained their usual colour.

3.—That, contrary to the assertion of Beddoes no organ, however vascular it might be, was ever found to be the seat of either inflammation or gangrene.

4.—That the muscles assumed a peculiar rosy red colour.

MM. Demarquay and Leconte next proceeded to investigate the action of oxygen upon the human subject. When it is applied locally to the surface of a wound or large sore, by means of an apparatus constructed specially of india-rubber, it gives rise to a slight feeling of heat and tingling, without pain. At first, no appreciable sensation is experienced in the limb to which the oxygen is applied, but if the apparatus is removed at the end of an hour, a slight increase of temperature (varying from 2-10ths to 6-10ths of a degree, centigrade), and some moisture of the surface of the limb, due to the retention of the perspiration, are perceptible. This increased temperature is of no practical importance; in fact, the application of

a similar apparatus, enclosing only atmospheric air, causes an equally great elevation of the heat of the limb. In the course of a few hours the suppuration becomes diminished in quantity and consistence, while the granulations assume a greyish colour, and appear to be smaller in size. After the removal of the oxygen, they again become red and swollen ; and if the application of the gas is renewed for several hours daily, more or less inflammatory action is produced. One of the most remarkable effects of the local employment of oxygen is, the rapid manner in which it modifies the congestive redness commonly present at the circumference of a wound ; and, in this way, the redness surrounding ulcers upon the extremities, and the vascular congestion of the skin observable after eczema, may be readily removed. This property of oxygen, employed locally, may be turned to advantage in the treatment of indolent and other forms of ulcers and wounds, as also in that of certain affections of the skin.

Although it is chiefly with the effects of oxygen, when inhaled, that I purpose to deal here, it may not be uninteresting to refer further to its local use.

The surgical affections in which it has been found of most service are senile gangrene, atonic or syphilitic sores, and varicose and other similar conditions of the lower extremities. The state of congested parts is successfully and quickly modified by the local application of oxygen; while, in the case of atonic ulcers, oxygen exercises a healthy degree of stimulation. The tunica vaginalis has been injected with oxygen in some cases of hydrocele without any ill consequence to the patients; in one instance, described by Demarquay, a permanent cure was produced.

When oxygen is applied to a recent sore, it causes little, if any, pain. After the wound has been subjected to its influence for an hour or longer, it is noticed that the fleshy granulations become soft and red, with a tendency to take on a greyish tint, and that they are, as it were, folded

on themselves, while the surface of the sore is covered with a sero-purulent fluid, generally somewhat abundant; this pus presents nothing peculiar, when examined under the microscope, but on the following day the excitation of the sore may have become so great that it is necessary to discontinue the further application of the gas. There is evidently some physico-chemical action produced by the oxygen, but by what chemical process it is accomplished is at present undeterminable. Whether, as in the lungs, absorption of oxygen takes place, with exhalation of other gases from the blood, or whether other phenomena occur, one thing is certain, viz.—that the local employment of oxygen produces on the wound a stimulating effect, which may rapidly pass on to actual inflammation.

The inhalation of oxygen has been found very useful in preparing delicate patients for surgical operations, by restoring their vital powers, and rendering them better able to bear the shock of a severe operation.

Demarquay and Leconte, found that a healthy person could readily inspire from twenty to forty litres of oxygen without any inconvenience or injury resulting from its inhalation ; and no ill effects have occurred from its employment by a large number of patients during an extended period. The daily inhalation of twenty to forty litres of this gas, continued for the period of a month or six weeks, gives rise to a moderate sensation of warmth in the throat and chest, occasionally accompanied by a slight headache.

As a rule, when oxygen is inhaled, the pulse at first increases, but in some few exceptional cases the reverse of this may be observed ; the inhalation is usually followed by increased appetite and general vigour, the improvement of the appetite being frequently very remarkable, and the digestive functions are similarly improved. These effects are not, however, so well-marked in patients who have been previously worn out by chronic disease, as in persons whose illness has been of shorter duration.

A singular alteration is perceived in sores, whether recent or old, after patients have inhaled the oxygen on several successive days; they become red and swollen, and suppurate much more freely than they had done previous to the commencement of the inhalation. This peculiar action of oxygen explains why its inhalation is sometimes attended by unsatisfactory results in the later stages of tubercular consumption. Patients in whom the affection has progressed to this point derive considerable benefit at the commencement of the practice of inhalation, but the inflammatory symptoms soon become more intense, (as in the case of external suppurating surfaces), and these are followed by excessive expectoration and more urgent cough, so that death would be accelerated if the inhalation were persevered in. In this manner, disastrous consequences have doubtless resulted in cases where persons, ignorant of the physiological properties of oxygen, have directed its indiscriminate employment; but this circum-

stance, instead of tending to depreciate the real value of the remedy, must be simply looked upon as furnishing a proof of the necessity which exists for proper professional advice before the adoption of inhalation, as well as before following any other method of medical treatment.

The therapeutical applications of oxygen are very numerous, but caution is required in its use, especially when certain contra-indications, which will be enumerated further on, are present. Oxygen is particularly serviceable in the treatment of cases of disease attended by an anæmic or chlorotic condition, in cases of debility, and in affections which exercise a depressing influence upon the system, such as, for instance, diphtheria, diabetes, and the secondary and tertiary forms of syphilis ; in affections of this character, if the age and general state of the patient are favourable, the inhalation of oxygen is soon followed by an improvement in strength and spirits, and often greatly increased appetite. The lips and skin

assume a more healthy colour, the eyes look clearer and brighter, greater vitality is manifest, and much of the nervous irritability previously present disappears.

During the course of the inhalation we must, however, inquire specially into the condition of the internal organs, and, in fact, of the whole body, because, as has been already stated, suppurating surfaces become so greatly modified in their character, under the stimulating effects of the oxygen, that inflammatory action is eventually set up, unless the case be carefully watched. At the same time the mere existence of a sore or wound is not, of itself, sufficient to contra-indicate the employment of oxygen; indeed, on the other hand, this remedy may not unfrequently be used with great advantage in the treatment of certain varieties of sores and ulcers, which are characterised by the absence of healthy vitality, and which consequently remain stationary, or heal only very slowly.

The action of oxygen is much sooner manifested in young than in old persons.

In the foregoing description of the physiological and therapeutical properties of oxygen, I have chiefly followed the reports presented to the Academy of Sciences of Paris, by MM. Demarquay and Leconte, because their researches have been more extensive than those of any other recent experimenters. Other observers, however, both in this country and on the Continent, have arrived at nearly similar conclusions.

Demarquay's and Leconte's observations offer a remarkable confirmation of the accuracy and carefulness of the trials conducted by Beddoes, Humphry Davy, and Thornton, upon oxygen as a therapeutic agent. These earlier writers were all agreed as to the remedial value of oxygen in certain classes of diseases, and as to the precautions requisite in administering it, particularly in the more advanced stages of phthisis.

The efficiency of oxygen is most clearly shown

in various affections attended by debility, and diminution of the red corpuscles of the blood. In asthma, and chronic bronchitis, it sometimes acts like a charm by relieving the difficulty of breathing, and restoring the patient to a healthy state. Dr. Beddoes, in writing of the effects of the respiration of oxygen in asthma and analogous pulmonary affections, made the following statement :—"No sooner does it touch the lungs than the livid colour of the countenance disappears, the laborious respiration ceases, and the functions of all the thoracic viscera go on easily and pleasantly again."

Dr. Daniel Hill, who was himself a martyr to this affection, has given his personal experience. He says, "Asthma seemed a disease best calculated, according to Dr. Beddoes' theory, for a trial of vital air, and in many cases of this complaint I had considerable success. Reflecting further upon this subject, I judged that in all cases of debility likewise, and where the action of the heart

and arteries was weak, it might prove extremely beneficial. As this was my own particular case, I was fully warranted to try it upon myself, and enabled thereby to make accurate observations. After having inhaled vital air for several weeks, occasionally taking such mild remedies as seemed necessary at the moment, I had the satisfaction to find myself in a state of health and strength which I had not experienced for the last seven years, owing to a gouty constitution, accompanied by nervous irritation, for which the use of medicine, under the direction of the late learned Dr. Warren, and others of the faculty, had not afforded the least relief."*

When inhaled during the earlier stages of consumption, it is productive of considerable benefit; although it is inadmissible in the later stages of

* Practical Observations on the use of Oxygen or Vital Air in the Cure of Disease. By Daniel Hill, M.D. London: 1820.

the disease, except it is resorted to occasionally, and for a few minutes only.

It will be interesting to give here a tabular statement of cases treated with inhalation of oxygen by Dr. Beddoes, from whose writings it has been compiled. This table is valuable, because it shows the wide field of Beddoes' observations, and gives the unsuccessful, as well as the successful cases. Beddoes remarks that if oxygen did not always accomplish the desired result, at any rate it never proved injurious to any of his patients, a point which Demarquay refers to, in making a similar remark based upon his own experience; so that the objections which have been frequently made to the inhalation of oxygen, on the score of the danger to the patient, are evidently groundless, when the administration of the gas is properly conducted.

*Result of Treatment by Oxygen, in Different Cases
related by Dr. Beddoes.*

Nature of the Affection.	Number of Patients Cured.	Number of Patients Relieved.	Number of Cases in which no effect was produced.
Asthma	10	9	3
Spasmodic Affections ...	3	2	—
Chronic Ulcers.....	2	2	—
Lepra, Psoriasis	5	—	—
Amaurosis.....	—	2	3
Chlorosis	5	2	—
Epilepsy	1	—	5
Cancer	—	3	—
Anasarca	2	1	1
Hydrothorax.....	2	1	1
Hydrocephalus.....	—	1	—
Dyspepsia	3	1	—
Headache	2	2	—
Poisoning by Opium ...	1	—	—
Paralysis	2	1	1
Scrofulous Tumours ...	2	1	—
White Swelling	1	—	—
Scurvy	1	—	—
Deafness	1	—	—
Venereal Disease	1	—	—
Melancholia	1	1	—
Hypochondriasis	—	1	—
General Debility	1	—	—
Continued Fever	1	—	—
Intermittent Fever	1	—	—
Deficient Circulation, with excessive Coldness of the Limbs	1	—	—
	49	30	14

The total number of the tabulated cases is 93, out of which 49, or more than half of the whole number, were cured, and 30, or one-third relieved, leaving only 14 in which no beneficial effects were obtained. It would be difficult to point out any other remedy capable of producing such satisfactory results in so wide a field of disease, comprising (as shown in the table) upwards of twenty different affections.

The observations of all subsequent writers on the subject of oxygen as a remedial agent, confirm the conclusions arrived at by Beddoes, and prove the value of oxygen in many other diseases not mentioned in the foregoing table.

The inhalation of oxygen is contra-indicated in disorders accompanied by much fever; in deep-seated inflammations and some visceral diseases; in most affections of the heart and large blood-vessels;* in neuralgia occurring in individuals of

* In Cyanosis, however, the inhalation of oxygen, properly employed, is productive of great benefit. The patient im-

plethoric temperament ; and when the hæmorrhagic diathesis, or acute congestion, is present.

The difficulties which formerly existed in connection with the practice of inhalation, such as those of obtaining the gases pure, and at any time or in any place, are now almost wholly removed.

With respect to oxygen, it may be prepared in any quantity within a moderate space of time, either for immediate use, or to be kept until it is required. The gas made from the chlorate of potash is the purest which can be procured. For this purpose the chlorate may be exposed to heat, either in a retort or in a flask furnished with a bent tube, and heated over the flame of a spirit lamp. The chlorate of potash melts and decomposes into oxygen, of which it yields a very large proportion, and chloride of potassium. The oxygen

proves in general health and strength, the colour of the face and lips becomes more natural and redder, and many of the signs of imperfect oxygenation disappear under this mode of treatment.

gas passes through the tube, and may be collected by means of a pneumatic trough, which consists of a vessel of water fitted with a shelf, upon which are placed, in an inverted position, the bottles intended to receive the gas. As the gas rises through the water, the latter is displaced from the inverted bottles, and as the bottles become filled, they may be removed, and others substituted in their place. The first portion of the gas which passes off generally contains a small per centage of chlorine, so that it should not be saved with the rest. When a little binocide of manganese is finely powdered and mixed with the chlorate of potash, and these two salts are exposed to the action of heat in a retort or flask, oxygen is produced very readily and at a much lower temperature than when the chlorate only is employed.

The oxygen may be subsequently collected into india-rubber bags of various sizes for use, as they may be required. Oxygen can be kept for several months in suitable india-rubber bags, without

undergoing any modification in its chemical nature, or loss of quantity, the only objection to its being preserved for a long time in these receptacles being that it is apt to acquire a somewhat disagreeable taste from the prolonged contact with the material of which the bags are composed. This may be obviated by passing the oxygen through a bottle containing water, which removes the disagreeable taste, while it prevents the irritation of the bronchial mucous membrane often caused by inhaling the gas direct from the apparatus in which it is made, or from the bags in which it is collected. If it be thought desirable, balsamic or other substances may be dissolved in the water through which the oxygen has to pass.

Another method of inhaling oxygen is by means of a porcelain vase, into which a portion of some oxygenating powder is introduced, hot boiling water being afterwards poured upon the powder. Oxygen is evolved, and can be inhaled through a tube connected with the upper part of the vessel.

The quantity of oxygen which may be inhaled at one sitting varies, according to the age, sex, and strength of the patient, and the nature of the case, from four to twenty pints, twice daily, or only once a day, at the commencement of the treatment.

The oxygen may also be more or less mixed with atmospheric air, according to the indications of the case; as a rule, the earlier inhalations of oxygen are apt to produce bronchial irritation, when the gas is unmixed with common air, so that the best plan is to begin with inhalations of oxygen and atmospheric air, mixed, gradually reducing the proportion of the latter as the treatment proceeds.

The period during which the oxygen inhalation should be continued, varies from a few minutes to a quarter of an hour or longer.

Besides oxygen, several other gases have been employed therapeutically, and some of them possess valuable qualities.

One of these is chlorine gas, which has been

very highly spoken of by some writers (especially Cottureau in the "Archives de Medicine," vol. xxiv.) on the treatment of phthisis, and has even been credited with the cure of this affection. The circumstances which first led to the employment of chlorine inhalations in the treatment of pulmonary disorders were rather singular. M. Gunnal, about 1817, being attached to a manufactory of printed calicoes at St. Dennis, observed that those workmen who happened to be affected with phthisical symptoms experienced great relief, while many rapidly recovered their health, owing to their inhaling the fumes of the chlorine disengaged in the various processes. Upon this fact being made known, various experiments were made with chlorine by different observers.

Louis, in his "Recherches sur la Phthisie," states, however, that he studied the action of chlorine on upwards of fifty consumptive patients, without the results being sufficiently satisfactory to warrant him in speaking so favourably of its beneficial

properties as other authors had done. It is probable that the apparent discrepancy on this point, as upon most of the medical questions about which there is a diversity of opinion, is principally due to the fact that the cases experimented on by various observers differed in either degree or kind, as well as to the circumstance that the remedial agent employed varied in purity or quantity in different cases. Louis admits that the inhalation of chlorine gas is efficacious in chronic pulmonary catarrh, on which he quotes M. Toulmouche, of Rennes, who carefully studied the effects of chlorine in the treatment of this affection and phthisis, but found it beneficial in the latter disease only.

The observations which I have made have led me to the same opinion as Louis, respecting the inutility of the inhalation of chlorine vapour in consumption. The inspiration of chlorine always produces, in healthy persons, very considerable irritation of the bronchial mucous membrane, cough-

ing, and expectoration, even when the gas is greatly reduced in strength by admixture with atmospheric air. These irritating effects of chlorine-inhalation are more strongly marked in cases of tubercular affection of the lungs, particularly in the advanced stages, and the sufferings of the patient appear to be greatly increased by its use.

In some diseases of the chest, when direct stimulation of the mucous membrane of the air-passages is indicated, chlorine, mixed with a large proportion of atmospheric air, may be advantageously employed; in chronic bronchitis, for example.

The other gases which have been most frequently used for inhalation are nitrous oxide, carburetted hydrogen, and carbonic acid; nitrogen and hydrogen have also been employed.

It is a singular fact that nitrogen, the most widely-diffused gas in existence, constituting four-fifths of the atmosphere which surrounds the globe, has formed the subject of so little investiga-

tion. As Demarquay observes, when once the exact composition of the atmosphere had been determined, when it had been ascertained that nitrogen was unfit for respiration, and consequently for sustaining life, and when a name had been given to it, chemists seemed to think that all had been said about it, and that there was nothing more connected with it which they need concern themselves about.

The number of writers who have paid attention to the subject of nitrogen as a therapeutical agent is very limited; of two of these only the titles of their works remain, and Nysten (*"Recherches de Physiologie et de Chimie Pathologique,"*) is almost the only author from whom any reliable information can be obtained. He pointed out that the inhalation of nitrogen mixed with oxygen, or atmospheric air, exerted a sedative effect upon the heart's action, and that it would be found valuable in the treatment of the more acute affections of the respiratory organs. Mare has also reported some

cases of phthisis in which it acted beneficially by diminishing the force of the circulation.

The experiments of M. Demarquay upon nitrogen have been principally confined to its local action upon wounds, when applied by means of india-rubber bags, in the same way as has been described in speaking of oxygen. He was led to use it by the consideration that nitrogen appears, in some degree, as simply the medium which holds oxygen in solution, so that by itself it possesses no exciting property; the pain and irritation felt in wounds exposed to atmospheric contact being really due to the oxygen of the atmosphere, and not to the nitrogen. The results of the application of nitrogen to various wounds confirmed M. Demarquay's theory, and led him to the following conclusions: 1.—That nitrogen, locally employed, tends to moderate the inflammatory action in wounds; 2.—That it also tends to promote adhesion, or union, by first intention. Reasoning by analogy, the inhalation of nitrogen would prove

useful in the treatment of certain affections of the lungs, in which it might be desirable to carry out these indications.

The remarks just made respecting the small number of experiments upon nitrogen will not apply to one of its compounds with oxygen, viz., the protoxide of nitrogen, or nitrous oxide, for there are few chemical substances which have formed the subject of more observation than this has done since its discovery by Priestley in 1776.

It may be readily prepared from the solid nitrate of ammonia, heated in a retort or flask, by which means the nitrate is converted into nitrous oxide and water, the former passing off by a long glass tube which is made to communicate with a suitable apparatus for receiving the gas. Care should be taken in the preparation of nitrous oxide to prevent its being rendered impure by the presence of nitric oxide gas or chlorine; the former is due to the employment of too great a degree of heat during the process, or to the adulteration of the nitrate of

ammonia with nitrate of silver or of copper, while the occasional presence of chlorine is owing to the use of impure nitrate of ammonia, which also contains chlorides.

From the intoxicating and exhilarating effects of protoxide of nitrogen when it is breathed, especially when it is free from admixture with atmospheric air, it has received the name of "laughing gas," by which it is commonly known.

These effects are quickly produced, but pass away with equal rapidity soon after the discontinuance of the inhalation. At about the third or fourth inspiration, a visible marked change comes over the person who is inhaling the gas. His face becomes pale, and his lips assume a violet hue ; increased muscular action shows itself in the frequent twitchings of the muscles of the face, in the violent heavings of the chest, and in the struggles of the patient to set himself at liberty. At this stage, the effects vary according to the individual. Many persons, when they have been brought under the

influence of nitrous oxide, are seized with an uncontrollable impulse to laugh loudly and continuously, at the same time manifesting their hilarious excitement by singing, dancing, and other gestures. Others repeat pieces of poetry which they have learned, or which they compose as they go on, or address imaginary assemblies, or comport themselves in a manner that shows them to be under the impression that they are kings, generals giving orders to large armies, or other great personages. All, in various ways, display pleasurable emotions, more or less excitement, greater activity of thought, and increased muscular action. If the inhalation of the gas is continued beyond this point, the symptoms of intoxication are more and more marked, as evidenced by inability to walk or speak, by helplessness and relaxation of the muscles, and by almost unconquerable desire to go to sleep. In some persons this drowsiness is produced much quicker than in others. Within a short time after the inhalation of the gas has been

discontinued, its effects pass off, merely leaving the patient somewhat exhausted by the violent exertions which he has made, and suffering from corresponding depression, which, however, is usually only slight and transient.

Struck by the certainty and rapidity with which these effects were produced, Davy suggested that by various combinations of nitrous oxide and carburetted hydrogen (which has properties opposite to those of nitrous oxide) we should be "in possession of a regular series of exciting and depressing powers, applicable to every deviation from health." Over-sanguine as he appears to have been in forming this anticipation, he made, in the course of his experiments, an important step in the direction of the discovery of anæsthetics; for, observing the comparative freedom from pain which the inhalation of nitrous oxide gave, he pointed out that as it was "capable of destroying physical pain, it might probably be used with advantage during surgical operations, not accom-

panied by great loss of blood." Slow as the researches commenced by Davy were in being brought to a successful practical termination, this was eventually done. Wells, a dentist, in the United States, attracted considerable attention, in 1844, to the mode by which he produced complete unconsciousness in patients previous to the extraction of teeth ; two years later, Morton, who had been a pupil of Wells, discovered the anæsthetic properties of ether ; and within twelve months afterwards, Simpson, of Edinburgh, announced the discovery of chloroform.

Next to Davy, Riadore has made a more complete study of the properties of nitrous oxide than any other writer ; not only, as regards the corroboration of Davy's observations upon its effects on the system, but also as regards its therapeutic influence. He gave it a trial in a large number of cases, and found it frequently successful, especially in the treatment of nervous affections. In many of Riadore's cases, treated by nitrous oxide, it

seems probable that the beneficial effects were due to the oxygen set free by the partial decomposition of this compound during its inhalation.

As bearing upon this point, as well as the general remedial value of nitrous oxide, the following passage may be quoted from an article on the Exercise of Respiration, by Sir Henry Holland, in his "Medical Notes and Reflections." "The disappointment of earlier and more sanguine expectation as to the medicinal value of the protoxide of nitrogen has had the result of withdrawing attention too much from this remarkable agent. That which can work such extraordinary effects upon the nervous system, affecting even the mind with a new sort of inebriety of thought and feeling, must, on the most assured grounds of analogy, be deemed capable of some remedial action, whatever its nature or degree. The inequality of influence upon different persons, and the disagreeable influence upon some, are circumstances common to all the powerful remedies we

possess, and cannot fairly be admitted in argument against its eventual use. Looking to the function of respiration in all its parts, it can scarcely be doubted that cases must occur where it may be important to add to the proportion of oxygen inspired; and the evidence of effects from this particular compound is sufficient to suggest it, under modification, as the most expedient method of attaining the object."

No very recent observations upon the therapeutic action of hydrogen have been recorded, but this gas undoubtedly possesses properties, if inhaled, which entitle it to some consideration. When a mixture of atmospheric air and hydrogen is breathed, the pulse becomes small and frequent, the lips and other superficial parts of the patient assume a bluish tinge, the body becomes colder, owing to the rapid abstraction of heat by the hydrogen, and the patient evinces great drowsiness, and sometimes finally falls into a sound sleep. Some of these phenomena soon show themselves,

the alteration of the pulse and the blueness of the skin coming on within a minute or a minute and a half after the commencement of the inhalation.

The proportion of hydrogen in the atmospheric mixture inhaled may range from one-fifth to four-fifths, according to the intensity of the effects required. Berzelius quotes a case described by Wetterstedt, of Stockholm. The patient, a consumptive young woman, inhaled for a quarter of an hour, a mixture containing four-fifths of hydrogen ; at the end of this time sound slumber was produced, although the patient had suffered habitually from want of sleep, and the same result was obtained upon every occasion when this plan of treatment was resorted to.

Beddoes found almost instantaneous relief from the inhalation of a mixture composed of one part of hydrogen, and six parts of atmospheric air, continued for a quarter of an hour, in cases of considerable inflammation of the lungs, with pain, full pulse and flushed countenance. He also states

that a similar plan of treatment proved efficacious in croup. He was first induced to try these inhalations by the theory that an air containing less oxygen than existed in atmospheric air would act as a narcotic,—an induction which was confirmed by experience. Several of the cases related by Beddoes present the same results as that already described in speaking of the narcotic properties of hydrogen. One is that of a consumptive patient, who, having for many months been obliged to take opium regularly every night to procure sleep, had this remedy omitted, and hydrogen inhalations substituted in its place; the result was that the patient slept longer and more soundly than he had previously done, under the effects of the opiate.

Reuss considered hydrogen inhalations beneficial in cases of rheumatism and paralysis.

Another mode in which *reduced* air, *i. e.*, an artificial air containing a smaller amount of oxygen than that contained in the atmosphere, has been

used, consists in the mixture of atmospheric air with carburetted hydrogen, in the proportion of one-part, or even less, at the commencement of this treatment, of the latter, to twenty of the former. A powerful sedative effect is produced by the respiration of this compound, of which sufficient evidence is afforded by the rapid lowering of the pulse, which sinks as much as ten beats in the minute, by vertigo, and drowsiness. It should at first be inhaled with caution, and considerably diluted,—viz., in the proportion of one pint of carburetted hydrogen to fifteen or twenty quarts of atmospheric air. As Dr. Darwin observes, "If the excitability of the system depends on the quantity of oxygen absorbed by the lungs in respiration, sleeping in (or inhaling) an atmosphere with less oxygen, might be of great service in epileptic cases, and in cramp, and in fits of asthma, where the periods of recurrence commence from increase of excitability during sleep." Reasoning from this point of view it might be

expected, and experience has confirmed this inference, that the inhalation of a lowered atmosphere would be attended by benefit in asthma, epilepsy, convulsions, and other spasmodic affections, as well as in inflammatory disorders of the lungs.

Occasionally, carbonic acid gas has been substituted for carburetted hydrogen, or hydrogen, in the composition of a reduced atmosphere, in the proportion of one part of carbonic acid gas to ten parts of common atmospheric air. Its use is indicated in the same class of cases as that in which the other forms of reduced atmosphere are employed. Drs. Percival and Withering have reported favourably of this treatment.

From the gases which have been enumerated, we may pass on to the consideration of the therapeutic properties of various chemical bodies which usually exist in the solid conditions, but may be volatilized by heat, so that their gaseous vapour may be inhaled.

One of the principal of these is iodine. As it

is slowly volatile at an ordinary temperature, and gives off vapour readily at an increased heat, it can be easily used for inhalation, by placing some iodine in a small box with a perforated lid, so that the vaporised iodine may pass through the openings; or some tincture of iodine may be added to hot water, when the iodine vapour passes off with the steam. Dr. Murray, in his Treatise on "The Influence of Heat and Moisture," states that he has employed iodine in the latter form, with much benefit to his patients. In all his cases he observed an improvement (at any rate, temporary, if not always permanent) in the condition of the patients; the force of the cough was diminished, the expectoration became more free, and sleep was more easily obtained under the influence of the iodine. Sir James Scudamore, in his work on the "Inhalation of Iodine and Conium in Tubercular Phthisis," describes a number of cases of pulmonary affections in which the inhalation of iodine was followed by marked improvement, and in many instances by

cure. The mode in which he recommends its administration differs, however, from that of Dr. Murray. The latter simply added tincture of iodine to hot water contained in a suitable vessel placed in the patient's room, so that the vapour of the iodine mixed with the steam from the hot water becomes diffused in the air of the apartment, and is respired by the patient. This simple mode of charging the atmosphere of a sick room with iodine, which is one of the best known disinfectants and deodorisers, is very useful in the management of fevers and other cases. Scudamore's method consists in placing an iodised solution in a glass apparatus, from which the patient inhales the vapour, by which means the quantity of the iodine inhaled can be better regulated. With the iodine, he was in the habit of combining conium, hydrocyanic acid, or some other sedative. When tincture of iodine, alone, is mixed with water, the iodine is separated into flakes, which become precipitated, and as 7000 parts of water are required to dissolve

the iodine, Scudamore found it expedient to make a preparation which should be of uniform strength, and preserve its transparency when mixed with water in any proportion. The following is the formula which he commonly adopted :—

Iodine, five grains ;
Iodide of Potassium, three grains ;
Distilled Water, five ounces ;
Alcohol, two drachms ;
Tincture of Conium, six drachms.

One or two drachms of this solution are to be placed in the inhaler with water at 120° of heat, and the vapour inhaled by the patient for fifteen or twenty minutes, three times a day. The periods of inhaling may be arranged so as to suit the patient's convenience ; but he should avoid going out into the open air for about an hour after the inhalations, unless in fine summer weather. If the stimulant effects of the iodine are too strongly marked, the treatment should be suspended for a few days, or a weaker solution, with a larger pro-

portion of conium, or hydrocyanic acid, should be employed. The solution should be added gradually during the inhalation, instead of the full quantity being placed at once in the inhaler, on account of the volatility of the iodine ; otherwise, if the whole amount intended for use were added at first, the iodine vapour would probably be too powerful at the commencement of the inhalation, and give rise to irritable cough and other annoying symptoms. The disease in which iodine inhalations are most indicated are, chronic bronchitis, asthma, and non-acute tubercular phthisis. Iodine may also be frequently inhaled with advantage by persons suffering from scrofulous affections, enlargement of the tonsils, sore throat, ozœna, and similar disorders.


One of the most recent writers upon this subject, M. Simon, reports in the "Union Médicale," for 1861, that out of twenty-eight patients who were treated by iodine inhalations, seventeen derived positive benefit, as regarded both the general and local symptoms, and four were completely cured,

Iodine has also been employed in this form in the treatment of cancer, but without the production of any apparently permanent good results.

The iodide of sulphur is sometimes administered as an inhalant, for humoral asthma and chronic bronchitis. Amongst those who have reported favourably of this remedy, Dr. Copland states that he has seen the inhalation of the vapour of iodide of sulphur attended by great benefit to the patient in asthma.

Carbolic acid, or phenol, is a chemical substance to which considerable attention has, of late years, been directed for inhalatory purposes. It is one of the products obtained by the distillation of coal tar, and when pure, exists in the shape of long, colourless crystals. At 95° it melts into an oily liquid, and at 370° it boils, passing off into vapour. It possesses powerfully escharotic, stimulant, and antiseptic properties.

Carbolic acid may be inhaled in various ways ; either by the patient breathing the vapour of hot



water, in which a small quantity of this substance has been placed, or by means of different inhalers. One of these, Calvert's Carbolic Acid Inhaler, manufactured by Rew & Co., Regent-street, is specially constructed for the administration of this remedy, and presents the great advantages of simplicity, portability, and uniformity of the strength of the inhalant. The inhaler made by Messrs. Rew & Co., possesses the additional superiority of being rendered fit for use by merely dropping the carbolic acid solution into it, without the necessity of hot water. This solution contains 35 per cent. of pure carbolic acid.

It may also be administered in the form of spray.* Dr. Marcet gives an account, in a recent number of the "Medical Practitioner," of a series of cases of pulmonary phthisis treated in this manner. The strength of the solution which he employed was from half a grain to a grain and a

* A description of this method of administering various medicines will be found in a later part of this work.

half of crystallized carbolic acid in an ounce of water. He reports that when the spray of this solution is inhaled in the chronic first stage of phthisis or at the commencement of the second stage, considerable relief is obtained ; the patient's breathing becomes easier and deeper ; there is less dyspnoea when the patient moves about ; the stitching pain in the chest is partly, or wholly, removed ; the cough is less troublesome ; and the expectoration is diminished. It appears as if the absorption of fluid in the smaller bronchi and pulmonary vesicles is promoted by the inhalation of the carbolic acid spray, as the crepitation is much diminished. In the advanced second and third stages of the affection, the inhalation of carbolic acid is objectionable, owing to its depressing influence over the heart's action ; an effect which results at any stage, if the strength of the solution is excessive. It is sufficient to inhale the spray once a day, or every other day, for fifteen or twenty minutes. Half a grain of hydrochlorate of

morphia may be advantageously added to each ounce of water in this solution. The apparatus used by Dr. Marcet was Clarke's Hand-ball Spray Producer, which he prefers to Siegle's, owing to the time and trouble involved in employing the latter inhaler.

Carbolic acid inhalations are also very useful in asthma, diphtheria, scarlet fever (especially the anginous form), and ozæna.

Arsenical inhalations were held in high esteem by the ancients in the treatment of asthma, bronchitis, catarrh, and some other affections of the lungs and air-passages. The preparation of this mineral which they used was a more inert substance than the arsenic employed in modern times. It was nearly identical in composition with yellow orpiment (tersulphide of arsenic), and is supposed to have consisted of sixty-two parts, in a hundred, of arsenic, and thirty-eight of sulphur,

according to the analysis of Klaproth.* Arsenic is not greatly used in inhalation at the present day, but cigarettes which have been steeped in a solution of arsenious acid are occasionally directed to be smoked by asthmatic patients. Various continental physicians have published cases in which no small degree of benefit is stated to have been obtained by smoking these cigarettes, known in France as "Cigares de Joie." Their use is not admissible when any organic disease of the heart co-exists.

Trousseau has recommended arsenious fumigation in Phthisis. He directs a sheet of white paper to be soaked in a solution containing one part of arseniate of soda to thirty parts of water. This paper is then made into small cigars, of which the patient smokes one or two daily, taking deep inspirations so as to draw the smoke into the lungs. At first, some amount of irritation is set

* *Vide* the Sydenham Society's Edition of the Works of Paulus Ægineta, vol 1. p. 480.

up; but, subsequently, the cough and expectoration diminish. Of eight cases detailed by Trousseau, four were very greatly relieved, while in the remainder it failed to give any marked relief.

The ethereal preparations, especially sulphuric ether, are often valuable as sedatives and antispasmodics, when they are inhaled. The vapour of sulphuric ether is indicated chiefly in chronic bronchitis, spasmodic asthma, neuralgia, and whooping-cough; it may be inhaled either by itself or combined with conium, or some other sedative. A few inspirations of air, containing a small proportion of chloroform, will be found very serviceable in allaying or removing the irritable cough of spasmodic asthma, and in neuralgia.

The inhalation of the vapour of boiling water containing camphor, conium, belladonna, hyoscyamus, stramonium, lobelia, hops, and other vegetable sedatives, is attended with beneficial results in all affections of the chest, where there is any local irritability or troublesome cough.

Tar, creosote, and turpentine have been recommended for use in a vaporised form, when stimulating remedies are indicated, for various pectoral diseases. The mode in which Sir Alexander Crichton, who was the first to advise the employment of tar, (*vide* Observations on Pulmonary Consumption) directs it to be used is, by heating the tar over a spirit lamp, a small quantity of sub-carbonate of soda having been previously added, so as to neutralize any pyroligneous acid which the tar may contain. The heat should be moderate, and the vapour be equally diffused throughout the air of the patient's room. Hufeland and other authors have borne corroborative testimony to the value of this remedy.

Nitrate of potash fumes have long been employed in a similar class of cases; and those of hydrochlorate of ammonia have been more recently well spoken of in cases where a stimulating plan of treatment is necessary. In using nitrate of potash, pieces of blotting-paper, previously soaked in a

saturated solution of the nitrate, and then dried, are burnt upon an earthenware plate ; the fumes soon become diffused throughout the room, and their beneficial effects are, in many cases, almost immediately rendered evident, as Sir Thomas Watson remarks, when writing on the value of this remedy in asthma, "by clearing out the air passages, and gradually opening the air-tubes."

The inhalation of the fumes of hydrochlorate of ammonia is recommended in asthma and chronic bronchitis by Paasch. They may be easily generated by pouring a little hydrochloric acid into a watch-glass placed in a saucer containing some liquor ammoniæ.

The different balsams and gum-resins which possess expectorant and stimulant properties may be volatilised by heat, and their vapours inhaled, with good results, in cases of asthma and bronchitis. Those most commonly employed in this manner are, the balsam of tolu, balsam of Peru, benzoin,

and storax.* Their efficiency may be increased by the addition of a little spirits of wine.

The benefit obtained by the inhalation of moist medicated vapours is attributable, in some measure, to the soothing effects of the steam of hot water in which the various remedial substances are dissolved. It is a beneficial practice for patients suffering from asthma, bronchitis, and other pulmonary affections, to inhale, at intervals, the simple vapour of heated water, at different degrees of temperature, according to the nature of the case, either with or without the addition of any medicinal

* As a direct proof of the antiquity of the practice of inhalation, the following passage may be quoted from a work written by Paulus Ægineta, who lived shortly after the commencement of the Christian era :—" To be inhaled for a continued cough. Take storax, pepper, mastick, Macedonian parsley, of each one ounce ; sandarach (probably the bisulphide of arsenic), six scruples ; two bay berries ; mix with honey, and fumigate by placing this compound upon hot ashes, so that the person affected with cough may inhale the vapour through a funnel. It answers also with those who are affected by a cold of any kind."

agent. The warm moist vapour is most agreeable to the patient, and seldom fails to afford speedy relief. The expectoration becomes more free, the cough is less frequent, and the dryness and irritation of the air-passages are removed or greatly diminished. The inhalation of the steam from boiling water, either simple or medicated, is very useful in the treatment of summer catarrh, or hay-fever, as I have pointed out in my work on the subject of this troublesome affection.*

There are numerous methods by which the patient may be enabled to inhale the steam, as, for instance, from a jug or basin containing hot water, or by breathing through a sponge which has been previously dipped in boiling water, and then partially wrung out. Several forms of apparatus have also been devised for this purpose ; two of the most efficient of these, whether for the inhala-

* On Hay-Fever, Hay-Asthma, or Summer-Catarrh. Fifth Edition. London : H. Renshaw.

tion of simple steam or of medicated vapour, are Nelson's Inhaler and Sturt's Inhaler.

Until a very recent period, only such remedial substances could be used in inhalation as could be administered in the gaseous form, or volatilised by heat into vapour, or dissolved in hot water and thus given off with the steam, so as to allow of their being drawn into the throat and lungs during the act of inspiration.

During the last few years, however, the discovery of the laryngoscope and additional investigation into the diseases of the larynx and air-passages generally, have led to the invention of new methods of applying local, or direct medication.

Of these, the most ingenious and, at the same time, the most important, are those which have for their object the minute sub-division of different remedial substances, so that when dissolved they can be inhaled in the form of spray.

The first apparatus invented for this purpose was that of Dr. Sales Girons, in 1858, to which

he gave the name of "Pulverisateur Portatif des Liquides Medicamenteux." It has since been modified and improved by several individuals, particularly Lewin, of Berlin, and Siegle, of Stuttgart.

The instrument devised by Sales Girons, in 1858, is so constructed that the medicated fluid is forced against a metal plate, by the agency of compressed air, through a small tube having a very fine aperture. The stream of fluid is checked at the metal plate, and it then becomes divided into fine spray (to which the term atomised, or pulverised, has been applied), and in this condition it can be inhaled by the patient.

A modification of this apparatus was introduced by Bergson, of Berlin, whose instrument comprises two glass tubes having capillary openings at one end,—these two ends being placed close to, but at a right angle with, each other. The more open end of the perpendicular tube dips down into a bottle containing the medicated fluid; as the com-

pressed air is forced through the horizontal tube, the air in the perpendicular one becomes exhausted, causing the medicated solution to rise in it ; when this arrives at the capillary opening, it is dispersed in the form of very fine spray, by the force of the compressed air passing through the upper tube.

The principle upon which this instrument acts is familiarly illustrated by the perfume odorators which have now been introduced into general use, and are, in fact, merely an adaptation to common purposes of Bergson's ingenious invention.

Siegle's atomiser is constructed on a similar principle to that just described, with the substitution of steam for compressed air as the propelling power.

Siegle's original apparatus, which is indiscriminately called an atomiser, a pulveriser, or a spray-producer, consists of a boiler, under which a spirit-lamp is placed ; a steam-tube passes from the upper part of the boiler, and carries off the steam which is generated in the boiler by the

application of the lighted spirit-lamp. This steam-tube, placed horizontally, is in close proximity at its capillary end to the capillary opening of an exhausting tube placed perpendicularly, so as to have its lower and larger end immersed in the fluid intended to be atomised. As the steam formed in the boiler passes along the horizontal steam-tube, the air in the upright exhausting tube is removed, and the medicated fluid then rises gradually to the capillary opening, where it encounters the jet of steam, coming from the horizontal tube, and is driven forwards in the form of very minute spray. The medicated fluid becomes warm, through admixture with the steam, and if the circumstances of the case appear to require it, the medicated solution may be made hotter by placing a small lighted spirit-lamp under the bottle in which it is contained. With the upper part of the boiler a glass tube containing mercury is connected ; the lower end of this tube, called a thermo-barometer, dips into the boiler,

while the other end projects upwards, and has upon it a graduated scale. As the mercury rises, it indicates the temperature and pressure most suitable for uniform atomisation and distribution of the spray.

More recently still, an improved apparatus has been devised by Dr. Siegle, of Stuttgart, upon the same principle. It consists of a copper boiler, generally bronzed, fastened to a brass stand, and placed over a spirit-lamp, which is provided with a screw to regulate the amount of flame. From the top of the boiler, the steam-tube passes horizontally, and terminates by a capillary opening, placed close to, and at right angles with, the capillary termination of a perpendicular exhausting tube, which communicates with a graduated glass bottle containing the medicated solution for inhalation. The boiler is fitted with a thermo-barometer, and it has also a spring safety-valve fitted to it, which readily permits of the escape of superfluous

steam when it is generated too rapidly, and thus insures perfect safety.

Dr. Siegle's inhaler presents numerous advantages over other apparatus of the same kind. It produces a finer and more uniform spray; the temperature of the spray can be conveniently raised to any desired point by placing a lighted spirit-lamp under the bottle which contains the medicated solution; the solution is brought into contact with glass only, so that the fluid does not become affected, nor the instrument injured, as would sometimes be the case if metallic tubes were employed; the apparatus is very simple and much less liable to become impaired than those which are worked by air-pumps, or springs; and, as it works of itself so long as any water remains in the boiler, and the spirit-lamp continues burning, it leaves the hands of the person administering the spray, at perfect liberty.

Another modification of Siegle's inhaler has recently come under my notice. It is known by

the name of the Adams' Inhaler, after Dr. Adams, of Glasgow, its inventor, and is efficient, portable, and economical.


Air may sometimes be more conveniently used than steam for the purpose of distributing the spray; and an ingenious apparatus in which air is employed has been designed by Dr. A. Clark. Instead of the boiler, with steam-pipe, as in Siegle's inhaler, an india-rubber tube is used for the purpose of generating the propulsive power; this is connected with the horizontal capillary tube, (two Bergson's tubes being used, one placed horizontally, and the other communicating with the solution-bottle, perpendicularly, as in Siegle's instrument), and is expanded at two different parts so as to constitute hollow balls. One of these serves as a reservoir for air, the other, situated further back, acts as an air-pump for forcing air into the rest of the tube. By alternately compressing and relaxing the hold upon this second ball, that which constitutes the reservoir becomes

distended as far as the network surrounding it will permit, and a continuous rush of air, causing a similarly continuous current of spray, is then produced. This instrument may be also used as an eye-douche, and for the application of lotions to painful sores or wounds. When properly worked, it produces a minute spray, and it can consequently be used to the most sensitive surfaces, *e. g.*, the eye-ball, without giving rise to any pain. The spray from this apparatus is, of course, cold ; but it may be rendered warm, either by making the medicated solution with hot water, or by applying a lighted spirit-lamp to the bottle in which the solution is contained.

Another spray-producer in which air is employed is that devised by Mr. Maunder. This instrument consists of a single india-rubber ball, perforated at the base, so as to admit more air, immediately it is emptied ; of an upper tube, continuous at one end with the air-ball, and terminating at the other by a capillary opening ; and of a lower tube, one


end of which dips into a glass containing the solution, the other terminating by a capillary orifice placed at right angles to the opening of the air-tube. When the operator's thumb is placed over the hole at the base of the ball, and quick forcible compression and relaxation is used, so as to force the air out of the ball, and to admit more air to take its place instantly, a tolerably fine spray is produced. By this means, any solution can be applied locally to the part of the larynx towards which the stream of spray is directed, and the instrument will therefore be found of great service in the treatment of laryngeal diseases when local medication is indicated ; it will also answer the purpose of a spray-producer for inhalatory treatment, although not so efficiently as the other inhalers which have been described.

It has been questioned by some, whether solutions divided into fine spray reach the lungs, but that they do so has been incontestably proved beyond a doubt by numerous observers. It seems



rather singular, indeed, that the doubt should have been seriously advanced, as it has long been a recognised fact that minutely pulverised substances floating in the atmosphere become drawn into the lungs of persons breathing it. Large depositions of black coal-dust, (so extensive as to be at first mistaken for melanosis, or black cancer,) which must have been inhaled during respiration, are found in the lungs of coal-whippers, and of persons who have been engaged for any considerable period in coal-mines; stone masons are peculiarly liable to inflammation of the lungs and consumption, owing to the introduction, during breathing, of minute particles of stone-dust into the lungs; and the steel-grinders of Sheffield suffer so severely from the constant respiration of an atmosphere loaded with the fine dust given off in the process of grinding the metal, that they frequently die of what is termed grinders' asthma (or, more emphatically, though less correctly in a pathological sense, grinders' rot) before reaching

the age of thirty. Other classes of workmen, such as chimney-sweeps, bakers, and dock-labourers engaged in unloading guano, are very susceptible to inflammatory affections of the lungs, brought on by breathing air contaminated with innumerable particles of dust. But, apart from all these proofs, evident to any observer, of the entrance of minutely divided substances into the lungs, it has been fully demonstrated that atomised solutions reach the lungs, when the spray is inhaled by the patient. In one striking case, experimented upon by M. Demarquay, it was shown incontestibly that the spray passed into the trachea. The case was that of a woman who had a tracheal fistula, and in whom, after she had inhaled the spray, the introduction of chemical tests through the tracheal opening proved the presence there of the various substances which had been inhaled, thus clearly showing that, at any rate, the spray which had been drawn in during the act of inspiration, had reached as far as the fistulous opening. The



most satisfactory proofs, however, of the entrance of the medicated spray into the air-passages and lungs, are the practical results which have been obtained by the administration, in this manner, of different remedial agents, and the marked and speedy benefit which arises from their employment in hæmoptysis, asthma, bronchitis, and other affections. In many cases of hæmoptysis, for instance, the hæmorrhage from the lungs is almost instantaneously checked by the inhalation of atomised solutions of various styptics, although the same remedies may have been previously given by the mouth, in very large doses, without any effect.

The medicinal agents which may be administered by means of the spray-producer are very numerous, (including, in fact, all which are capable of solution in water), and the indications for their use are the same as those followed when they are taken internally in the ordinary way. The dose of some of the more powerful remedies differs in conse-

quence of the readiness with which absorption of the medicated spray takes place ; and it must also be borne in mind that, in some disordered conditions of the lungs, the tendency to absorption is greater than in the healthy state.

The following is a list of some of the principal remedies which are employed in this manner ; in each case the quantity named is to be dissolved in one ounce of water :—

Nitrate of silver, 1 to 5 grains ;

Alum, 2 to 20 grains ;

Tannic acid, 2 to 15 grains ;

Hydrochlorate of ammonia, 1 to 10 grains ;

Extract of belladonna, $\frac{1}{4}$ grain to 2 grains ;

Extract of cannabis Indica, $\frac{1}{8}$ grain to 2 grains ;

Extract of conium, $\frac{1}{2}$ grain to 3 grains ;

Extract of hyoscyamus, $\frac{1}{2}$ grain to 4 grains ;

Acetate of morphia, or

Hydrochlorate of morphia, $\frac{1}{8}$ grn. to 2-3rds of a grn ;

Bromide of potassium, 1 to 10 grains ;

Iodide of potassium, 1 to 10 grains ;

Bicarbonate of potash, 10 to 40 grains ;

Chlorate of potash, 2 to 10 grains ;
 Chloride of sodium, 5 to 20 grains ;
 Sulphate of quinine, 1 to 3 grains ;
 Acetate of lead, 3 to 10 grains ;
 Liquor arsenicalis, 2 to 10 minims ;
 Tinctura ferri perchloridi, 5 to 30 minims ;
 Glycerine, $\frac{1}{2}$ drachm to 2 drachms ;
 Tincture of opium, 3 to 20 minims ;
 Tincture of iodine, 1 to 10 minims ;
 Liquor calcis, 2 drachms to half-an-ounce.

Before concluding the description of this method of inhalation, mention must be made of some general advantages derivable from the employment of Siegle's apparatus, apart from the special benefit which results from the inhalation of any particular remedy.

These general advantages are : 1.—That the steam inhaled has a soothing, calmative effect ; 2.—That the deep, prolonged, and steady inspirations taken by the patient during inhalation, promote complete expansion of the chest, and help to bring the patient into a habit of more

completely filling the lungs at each act of inspiration ; and 3.—That by administering remedies in this way, we avoid the disturbance of the digestive functions which frequently occurs when medicines are taken into the stomach in the usual manner by confirmed invalids, or patients subject to weak digestion.

There is a method of inhaling dry atmospheric air, distinguished from that of inhaling moist vapours, which deserves notice, from having met with considerable favour amongst continental practitioners, viz.—the treatment of chest diseases by compressed air. The patient is placed in a sitting position in an air-tight room, into which additional air is gradually forced by pressure ; after sufficient condensation has been obtained, it is kept at this point for a definite period, and gradually lowered. This mode of treatment has a remarkable power of lowering the circulation, and of rendering the breathing more easy and natural.

The idea of employing this peculiar treatment

is stated in the "Gazette Médicale de Paris" to have originated in the circumstance that several of the workmen who were engaged in sinking the foundations of a bridge, and happened to suffer from various chest affections, were comparatively free from their complaints when they were at work in the caissons sunk below the surface of the water. Establishments at which patients are subjected to the effects of condensed air have been formed at Lyons, Montpellier, and other places; and the medical superintendents of these establishments describe this plan as successful in catarrh, chronic bronchitis, asthma, debility, &c. The pressure used is from 1.5th to $\frac{1}{2}$ more than the ordinary atmosphere.

The inhalation of condensed air should always be resorted to with great precaution, owing to its excessively depressing effect upon the heart's action.

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